CLAIMS

I claim:

1. A miniaturized thin-film fuel cell for converting chemical energy of a fuel containing hydrogen into an electrical current without combustion comprising:

a manifold structure constructed from a substrate having a face surface and an elongate fuel chamber defined therein for receiving the fuel, said fuel chamber having an elongate opening along said face surface;

an elongate electrolyte secured between an anode positioned adjacent to said fuel chamber and a cathode positioned adjacent to an oxygen containing region, said electrolyte operably secured to the face surface of said substrate adjacent to said fuel chamber thereby hydraulically isolating said fuel chamber from the oxygen containing region; and

wherein fuel received within said fuel chamber is operably engaged with the anode along the length of the elongate opening, and oxygen from the oxygen containing region is operably engaged with the cathode such that when encouraged by a catalyst, hydrogen atoms from the fuel split into a proton and an electron, which take different paths to the cathode thereby producing the electric current.

2. The miniaturized thin-film fuel cell of claim 1, wherein said substrate is a silicon wafer.

3. The miniaturized thin-film fuel cell of claim 1, wherein said substrate is a portion of a silicon wafer.

4. The miniaturized thin-film fuel cell of claim 1, further including:

a plurality of elongate fuel chambers received within the substrate, each said fuel chamber of the plurality of elongate fuel chambers having a elongate opening along said face surface and in fluid communication with the other each of said plurality of fuel chambers; and

a plurality of elongate electrolytes secured between anodes, one positioned adjacent to each of said fuel chambers and cathodes positioned adjacent to the oxygen

containing region, said electrolytes operably secured to the face surface of said substrate, one each positioned adjacent to each said fuel chambers of the plurality of fuel chambers, thereby hydraulically isolating said plurality of fuel chambers from the oxygen containing region.

5. The miniaturized thin-film fuel cell of claim 1, wherein said fuel cell is a proton exchange membrane fuel cell and the electrolyte is a proton conducting electrolyte material.

6. The miniaturized thin-film fuel cell of claim 5, wherein said proton conducting electrolyte material is a perfluorinated sulfonic acid polymer having a thickness between 50-100 μm, inclusive.

7. The miniaturized thin-film fuel cell of claim 1, further including:

a second manifold structure constructed from a second substrate having a second face surface and a second elongate fuel chamber defined therein for receiving the fuel, said second fuel chamber having an elongate opening along said second face surface;

a second elongate electrolyte secured between a second anode positioned adjacent to said second fuel chamber and a second cathode positioned adjacent to the oxygen containing region, said second electrolyte operably secured to the second face surface of said second substrate adjacent to said second fuel chamber thereby hydraulically isolating said second fuel chamber from the oxygen containing region; and

wherein fuel received within said second fuel chamber is operably engaged with the second anode along the length of the second elongate opening, and oxygen from the oxygen containing region is operably engaged with the second cathode such that when encouraged by a catalyst, hydrogen atoms from the fuel split into a proton and an electron, which take different paths to the second cathode thereby producing electric current.

8. The miniaturized thin-film fuel cell of claim 7, wherein the manifold structure and second manifold structure are spaced apart from each other and operably secured within a frame to define first and second oxygen containing regions within said frame.

9. The miniaturized thin-film fuel cell of claim 7, wherein:

said substrate has a back surface and said elongate fuel chamber extends through the substrate defining a back opening along said back surface; and,

said second substrate has a second back surface and said second elongate fuel chamber extends through the second substrate defining a second back opening along said second back surface;

wherein said first and second substrates are bonded together along their respective back surfaces such that said elongate fuel chamber and said second elongate fuel chamber are in fluid communication with each other.

10. The miniaturized thin-film fuel cell of claim 9, including a plurality of said miniaturized thin-film fuel cells, each such fuel spaced apart from the other of the plurality of said miniaturized thin-film fuel cells by a frame.

11. The miniaturized thin-film fuel cell of claim 10, wherein the fuel chambers of the plurality of said miniaturized thin-film fuel cells are in fluid communication with each other.

12. The miniaturized thin-film fuel cell of claim 11, wherein said the fluid communication between the fuel chambers of the plurality of said miniaturized thin-film fuel cells is in a serpentine or parallel pattern.

13. The miniaturized thin-film fuel cell of claim 9, further including a

a plurality of elongate fuel chambers received within the substrate, each said fuel chamber of the plurality of elongate fuel chambers having a elongate opening along said face surface and in fluid communication with the other of each of said fuel chambers of said plurality of fuel chambers;

a plurality of elongate electrolytes secured between anodes, one positioned adjacent to each of said elongate fuel chambers of said plurality of elongate fuel chambers and cathodes positioned adjacent to the oxygen containing region, said electrolytes operably secured to the face surface of said substrate, one each positioned adjacent to

each said fuel chamber of the plurality of fuel chambers, thereby hydraulically isolating said fuel chambers from the oxygen containing region.

a plurality of elongate second fuel chambers received within the second substrate, each said second fuel chamber of the plurality of elongate second fuel chambers having a second elongate opening along said second face surface and in fluid communication with the other fuel chambers of said plurality of fuel chambers; and

a plurality of elongate second electrolytes secured between anodes, one positioned adjacent to each of said second fuel chambers and cathodes positioned adjacent to the oxygen containing region, said second electrolytes operably secured to the second face surface of said second substrate, one each positioned adjacent to each said second fuel chambers of the second plurality of fuel chambers, thereby hydraulically isolating said plurality of elongate second fuel chambers from the oxygen containing region;

wherein the fuel chambers of the substrate and the second fuel chambers of the second substrate are in fluid communication with each other.

14. A method for making a thin-film fuel cell including a manifold structure made from a substantially planar thin-film substrate having a face surface, comprising the steps of:

defining an elongate fuel chamber in the thin-film substrate such that the chamber provides an elongate opening along the face surface of the substrate;

operably securing an elongate proton exchange membrane-electrode assembly, having an anode and cathode, to said substrate and adjacent to said elongate fuel chamber;

filling said fuel chamber with fuel containing hydrogen such that the fuel operably engages with the anode along the length of the elongate opening, and oxygen from an oxygen containing region is operably engaged with the cathode such that when encouraged by a catalyst, hydrogen atoms from the fuel split into a proton and an electron, which take different paths to the cathode thereby producing electric current.

15. The method of making a thin-film fuel cell of claim 14, further including the step of stacking a plurality of said thin-film fuel cells in a frame such that the thin-film

fuel cells within the frame are spaced apart from each other, but in electrical communication with each other.

16. The method for making a thin-film fuel cell of claim 14, further including the steps of:

defining an elongate second fuel chamber in a second thin-film substrate such that the second chamber provides a second elongate opening along the second face surface of the second substrate;

operably securing a second elongate proton exchange membrane-electrode assembly, having a second anode and a second cathode, to said substrate and adjacent to said second elongate fuel chamber;

bonding said thin-film substrate and said second thin-film substrate together such that said elongate fuel chamber and said second fuel chamber are in fluid communication with each other; and

filling said second fuel chamber with fuel containing hydrogen such that the fuel operably engages with the second anode along the length of the elongate opening, and oxygen from an oxygen containing region is operably engaged with the second cathode such that when encouraged by a catalyst, hydrogen atoms from the fuel split into a proton and an electron, which take different paths to the cathode thereby producing electric current.

17. The method of making a thin-film fuel cell of claim 16, further including the step of stacking a plurality of said thin-film fuel cells in a frame such that the thin-film fuel cells within the frame are spaced apart from each other, but in electrical communication with each other.